NOT MEASUREMENT SENSITIVE

NOTE: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

MIL-STD-188-197A
12 October 1994
SUPERSEDING
MIL-STD-188-197
18 June 1993

DEPARTMENT OF DEFENSE
INTERFACE STANDARD

ADAPTIVE RECURSIVE INTERPOLATED DIFFERENTIAL PULSE CODE MODULATION (ARIDPCM) COMPRESSION ALGORITHM FOR THE NATIONAL IMAGERY TRANSMISSION FORMAT STANDARD

AMSC N/A

AREA TCSS

FOREWORD

1. The National Imagery Transmission Format Standard (NITFS) is the standard for formatting digital imagery and imagery-related products and exchanging them among members of the Intelligence Community (IC) as defined by Executive Order 12333, the Department of Defense (DOD), and other departments and agencies of the United States Government, as governed by Memoranda of Agreement (MOA) with those departments and agencies.

2. The National Imagery Transmission Format Standards Technical Board (NTB) developed this standard based upon currently available technical information.

3. The DOD and members of the Intelligence Community are committed to interoperability of systems used for formatting, transmitting, receiving, and processing imagery and imagery-related information. This standard describes Adaptive Recursive Interpolated Differential Pulse Code Modulation (ARIDPCM) compression algorithm for the National Imagery Transmission Format (NITF) file format and establishes its application within the NITFS.

4. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Defense Information Systems Agency (DISA), Joint Interoperability and Engineering Organization (JIEO), Center for Standards (CFS), Attn: TBCE, Parkridge III, 10701 Parkridge Blvd., Reston, VA 22091-4398, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

CONTENTS

CONTENTS

PARAGRAPH PAGE

FIGURE

CONTENTS

1. SCOPE

1.1 Scope. This standard establishes the requirements to be met by complying with NITFS systems when image data are compressed using the Adaptive Recursive Interpolated Differential Pulse Code Modulation (ARIDPCM) compression algorithm.

1.2 Content. This standard provides technical detail of the NITFS compression algorithm designated by the code C2 in the image compression field of the image subheader, ARIDPCM, for both 8- and 11-bit gray scale imagery. It also provides the required default ARIDPCM quantization tables for use in NITFS compliant Secondary Imagery Dissemination Systems (SIDS).

1.3 Applicability. This standard is applicable to the Intelligence Community and the Department of Defense. It is mandatory for all SIDS in accordance with the memorandum by the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence ASD(C^3I) Subject: National Imagery Transmission Format Standard (NITFS), 12 August 1991. This directive shall be implemented in accordance with the JIEO Circular 9008 and MIL-HDBK-1300A. New equipment and systems, those undergoing major modification, or those capable of rehabilitation shall conform to this standard.

1.4 Tailoring task, method, or requirement specifications. The minimum compliance requirements for implementation of this compression algorithm are defined in JIEO Circular 9008.

1.5 Types of operation. This standard establishes the requirements for the communication or interchange of image data in compressed form. The ARIDPCM defined by this standard consists of three parts: the compressed data interchange format which defines the image data field of the NITF file format, the encoder, and the decoder. Two types of operation are specified by the acquisition authority.

Type 1 - 8-bit sample compression

Type 2 - 11-bit sample compression

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

FEDERAL

FED-STD-1037B	-	Telecommunications: Glossary of Telecommunication Terms.

MILITARY

MIL-STD-2500A	-	National Imagery Transmission Format (NITF) Version 2.0 for the National Imagery Transmission Format Standard (NITFS).

HANDBOOK

MILITARY

MIL-HDBK-1300A	-	National Imagery Transmission Format Standard (NITFS).

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

DISA/JIEO Circular 9008	-	NITFS Certification Test and Evaluation Program Plan.

(Copies of DISA/JIEO Circular 9008 may be obtained from DISA/JITC ATTN: GADB Bldg. 57305 Ft. Huachuca, AZ 85613-7020).

2.2 Non-Government publications. No Non-Government publications form a part of this document.

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Acronyms used in this standard. The following definitions are applicable for the purpose of this standard. In addition, terms used in this standard and defined in the FED-STD-1037B shall use the FED-STD-1037B definition unless otherwise noted.

a.	ARIDPCM	Adaptive Recursive Interpolated Differential Pulse Code Modulation
b.	ASCII	American Standard Code for Information Interchange
c.	BAM	Bit Assignment Matrix
d.	bpp	bits per pixel
e.	BPS	Bits Per Second
f.	CFS	Center for Standards
g.	COMRAT	Compression Rate Code
h.	DISA	Defense Information Systems Agency
i.	DOD	Department of Defense
j.	DODISS	Department of Defense Index of Specifications and Standards
k.	DPCM	Differential Pulse Code Modulation
l.	IC	(1) Image Compression (2) Intelligence Community
m.	ISO	International Organization for Standardization
n.	JIEO	Joint Interoperability and Engineering Organization (formerly JTC^3A)
o.	JPEG	Joint Photographic Experts Group
p.	MOA	Memoranda of Agreement
q.	NITF	National Imagery Transmission Format
r.	NITFS	National Imagery Transmission Format Standard
s.	NTB	National Imagery Transmission Format Standard Technical Board

t. SIDS Secondary Imagery Dissemination System

u. VHSIC Very High Speed Integrated Circuit

3.2 Definition of terms. The definitions used in this document are defined as follows:

a. Band - For the purpose of NITFS, used interchangeably with component. (See component.)

b. Bit rate - In a bit stream, the number of bits occurring per unit time, usually expressed as bits-per-second (BPS). Note: For M-ary operations, the bit rate is equal to $\log_2 M$ times the rate (in baud), where M is the number of significant conditions in the signal.

c. Brightness - An attribute of visual perception, in accordance with which a source appears to emit more or less light. Note 1: Usage should be restricted to nonquantitative reference to physiological sensations and perceptions of light. Note 2: "Brightness" was formerly used as a synonym for the photometric term "luminance" and (incorrectly) for the radiometric term "radiance." For the purpose of NITFS, larger pixel values represent higher intensity, and lower pixel values represent lower intensity levels.

d. Busyness code - A code associated with the ARIDPCM image compression algorithm corresponding to the dynamic range of an 8x8 pixel neighborhood.

e. Byte - A sequence of N adjacent binary digits, usually treated as a unit, where N is a non zero integral number. Note: In pre-1970 literature, "byte" referred to a variable length field. Since that time the usage has changed so that now it almost always refers to an eight-bit field. This usage predominates in computer and data transmission literature; when so used, the term is synonymous with "octet." For the purpose of MIL-STD-188-198B (JPEG), a byte is defined as an eight-bit octet.

f. C2 - The code used to indicate the ARIDPCM compression algorithm in the image compression (IC) field of the image subheader.

g. Component - For the NITFS, one of the two-dimensional arrays that comprise an image. Used interchangeably with band.

h. Compression rate - The bit representation of the compressed image in bits per pixel.

i. COMRAT - The compression rate code field in the NITF image subheader used to indicate the quantization matrices used.

j. Data - Representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means. Any representations such as characters or analog quantities to which meaning is or might be assigned.

k. Differential Pulse Code Modulation (DPCM) - A version of pulse-code modulation in which an analog signal is sampled, and the difference between the actual value of each sample and its predicted value (derived from the previous sample or samples) is quantized and is converted by encoding to a digital signal. Note: There are several variations on differential pulse-code modulation.

l. Gray scale - An optical pattern consisting of discrete steps or shades of gray between black and white.

m. IC - The Image Compression field of the NITF image subheader.

n. Neighborhood - An 8x8 blocked region of pixels.

o. Pixel - For the purpose of NITFS, the smallest element from an N band image. Each pixel consists of N samples taken from corresponding locations in each of the image bands. For a single band image, sample and pixel can be used interchangeably.

p. Sample - For the NITFS, one element in the two-dimensional array that comprises a band of the image.

4. GENERAL REQUIREMENTS

4.1 Interoperability. The requirements specified in this standard are intended to ensure commonality between compressing and decompressing 8- and 11-bit imagery with ARIDPCM. This provides data interoperability among NITFS compliant systems.

4.2 ARIDPCM. The fundamental concept of the ARIDPCM algorithm is to predict image pixel values by simple linear and bilinear interpolation, then subtract the predicted value from the original value to achieve a delta (Δ) value. By quantizing, this delta value is converted to fewer bits, providing data compression. The ARIDPCM is defined with 4 selectable compression rates (4.5, 2.3, 1.4, and 0.75 bits per pixel, bpp) for 8-bit data and 4 selectable compression rates (6.4, 4.5, 2.3 and 1.4 bpp) for 11-bit gray scale images. These rates are specified by the (compression rate code) COMRAT field in the NITF image subheader.

4.3 Encoder. The ARIDPCM algorithm partitions the original image into 8x8 pixel neighborhoods, generating hierarchical prediction matrices for those neighborhoods, then quantizing the difference images (original - predicted) at each level of the hierarchy.

4.3.1 Recursion levels. Each image is subdivided into 8x8 pixel neighborhoods beginning at the upper left corner of the image and proceeding from left-to-right and top-to-bottom to the lower right corner. Each neighborhood is comprised of pixels at different recursion levels; one Level 1 pixel (L1), three Level 2 pixels (L2), 12 Level 3 pixels (L3), and 48 Level 4 pixels (L4) (figure 1 for Level map).

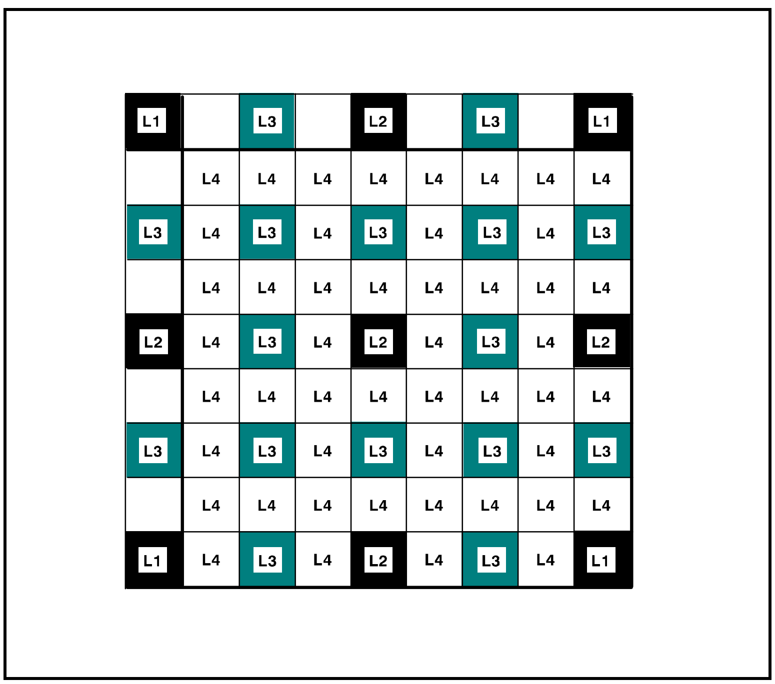


FIGURE 1. The levels of the ARIDPCM 8x8 block.

A prediction matrix is computed for each neighborhood by using an additional column to the left and an additional row to the top of the neighborhood. In total, a 9x9 subimage block encompassing the neighborhood of interest is required to create its prediction matrix. If the neighborhood of interest borders the top or left edge of the image, an artificial 9^{th} row and/or column is created by copying the first row or column in the neighborhood respectively, and $L_{8,8}$ is assigned $L_{0,0}$ (see 5.2.1). A similar approach is taken when the neighborhood of interest is less than 8x8 pixels (for example, on the bottom or rightmost edge). Linear and bilinear interpolation algorithms are used to compute the prediction matrix for each neighborhood.

4.3.2 Quantization. Each difference neighborhood is classified in terms of its activity. A measure of activity is "Busyness," which is the maximum difference of the Level 4 delta pixels.

$$\text{Busyness} = \text{Max}(\Delta_4) - \text{Min}(\Delta_4)$$

Each difference neighborhood is classified as either an A, B, C, or D Busyness with D being the busiest. The difference pixel is quantized with the use of hard coded look-up quantization tables that depend on the busyness class, level of the pixel, and the difference value of that pixel. The Level 1 pixels always are quantized to their full image resolution.

4.3.3 Coding. The quantized levels are coded with a constant-length binary look-up table code. The number of bits in the Bit Assignment Matrix (BAM), the compression rate, and the quantized value are used as indexes into the look-up table. Appendix A specifies the BAMs and quantization tables for compression of eight-bit gray scale images to 0.75 bpp. All other BAMs and quantization tables are maintained on magnetic media as appendix B to this document.

4.4 Decoder. To decode (reconstruct) the image, the reverse of the compression process is used. From the compression rate in the NITF image subheader and the busyness code preceding the coded data for a given 8x8 neighborhood, the BAM is used to determine the number of bits at which each level has been coded. The Level 1 corner point always remains in its original form with the actual pixel value $L_{0,0}$ at full resolution, therefore, no dequantization is required. Other pixels at full resolution are treated similarly. Next, the expected value for each of the coded deltas ($E[\Delta]$) are obtained from the quantization look-up tables.

4.5 Compressed data format. Figure 2 shows the NITF file format of the compressed data for the above configuration. All the busyness codes are placed together prior to all the neighborhoods.

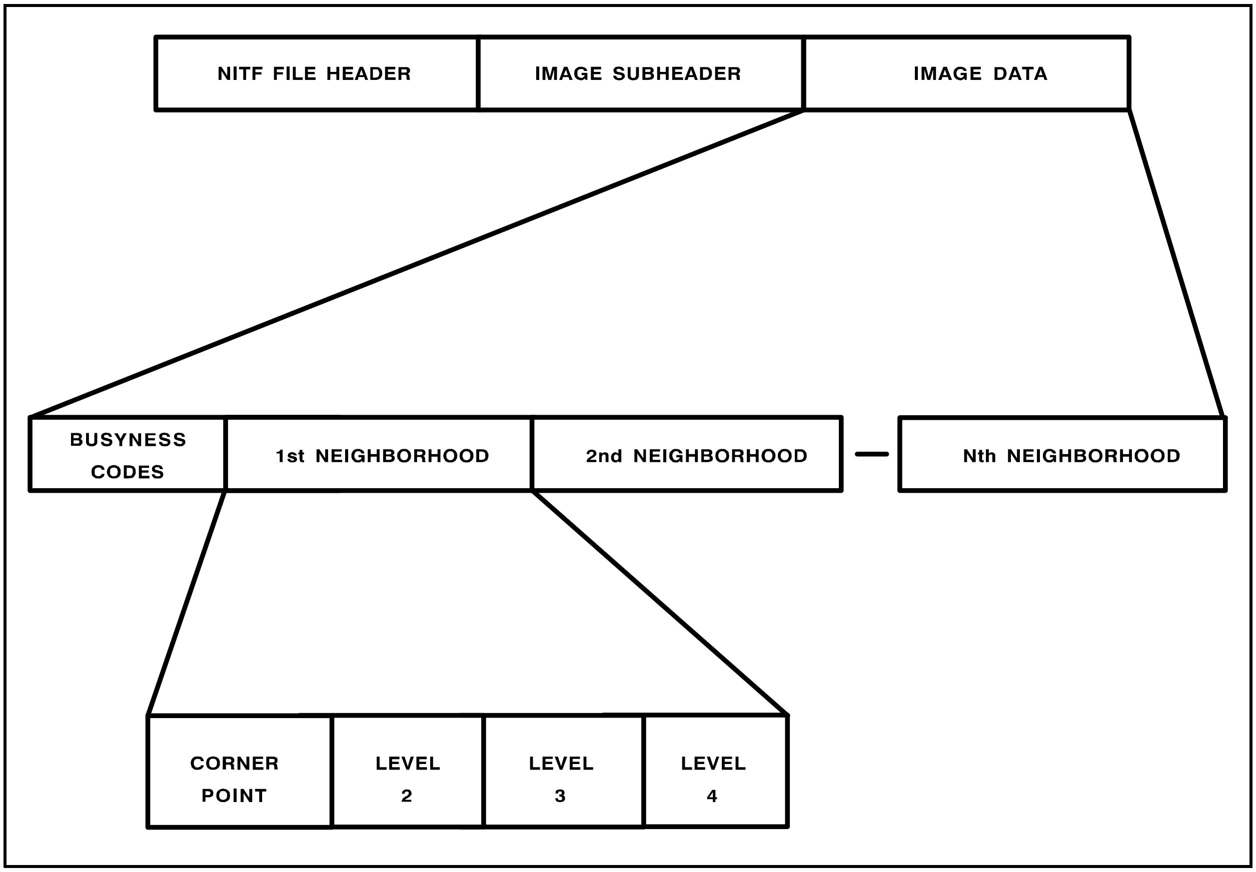


FIGURE 2. Format of an NITF file.

4.6 Modes of operation. The various coding processes are defined under three distinct modes of operation:

a. Driven

b. Non-driven

c. Composite

The non-driven algorithm is chosen when a specific image quality is desired but the length of the coded image is variable. To guarantee a specific average number of bits per pixel over the entire image, the driven algorithm is chosen. The driven algorithm is a two pass operation, whereas, the non-driven algorithm is performed in one pass. The composite algorithm compresses areas of low interest to a greater degree than areas of high interest. Decompression is performed identically for all three types. The differences among the modes are in the specification of the busyness class of the neighborhood or the selection of the BAMS used on the neighborhood.

4.6.1 Non-driven mode. The non-driven algorithm is locally adaptive over an 8x8 pixel neighborhood. The BAM is selected by the busyness measurement of the neighborhood for a selected compression rate.

4.6.2 Driven mode. The driven algorithm is globally adaptive while the non-driven is locally adaptive over an 8x8 pixel neighborhood. The driven algorithm is computed in the same manner as the non-driven until the selection of the BAM. The driven algorithm is a two pass operation. On the first pass the busyness measures of each neighborhood are calculated. All deltas for every neighborhood in the image are computed prior to selection of any BAMs. A specific percentage of the neighborhoods are then placed into each busyness class to reach the user-selected compression rate.

4.6.3 Composite mode. Composite mode of the algorithm combines driven and non-driven techniques to compress areas of little interest more than higher interest areas. The region of interest is specified by the operator, and this region is coded using the highest BAM for the selected compression rate. The rest of the area is coded using the lowest BAM. Image detail is preserved by using more bits to maintain higher image fidelity over the region of interest. The system developer determines the exact use of the composite mode.

4.7 Amount of compression. The amount of compression provided by any of the various processes depends on the compression rate chosen and, for the non-driven mode and composite mode, on the particular image being compressed.

5. DETAILED REQUIREMENTS

5.1 General. This section includes detailed requirements for compressing and decompressing 8- and 11-bit gray scale image data using ARIDPCM. The basic algorithm for both 8- and 11-bit imagery is the same.

5.2 ARIDPCM. ARIDPCM is a spatial compression algorithm currently defined for 8- and 11-bit gray scale images. The ARIDPCM is defined with four selectable compression rates (4.5, 2.3, 1.4, and 0.75 bits per pixel, bpp) for 8-bit data and 4 selectable compression rates (6.4, 4.5, 2.3 and 1.4 bpp) for 11-bit gray scale images. These rates are specified by the COMRAT field in the NITF image subheader.

5.2.1 Fundamental concept. The fundamental concept of the algorithm is to predict image pixel values by simple linear and bilinear interpolation and subtract the predicted values from the original value to achieve a delta (Δ) value. By quantizing, this delta value is converted to fewer bits, thus providing data compression. There are three modes of ARIDPCM:

a. Non-driven

b. Driven

c. Composite

The non-driven algorithm is chosen when a specific image quality is desired, but the length of the coded image is variable. To guarantee a specific average number of bpp over the entire image, the driven algorithm is chosen. The driven algorithm is a two pass operation. The non-driven algorithm is performed in one pass. The composite algorithm compresses areas of low interest to a greater degree than areas of high interest. Decompression is performed identically for all three types.

The following notation is used throughout the remainder of the description of the ARIDPCM.

$\Delta_{i,j} = L_{i,j} - P_{i,j}$
$L_{i,j}$ = Actual pixel value at pixel i,j
$P_{i,j}$ = Predicted pixel value at pixel i,j

i = the i^{th} row of the 8x8 neighborhood
j = the j^{th} row of the 8x8 neighborhood

NOTE: The ARIDPCM algorithm is designed with a reference point in the lower right corner of a neighborhood. As a result, the description of the algorithm is greatly simplified with a deviation from the standard coordinate system. The coordinate system for an ARIDPCM neighborhood has an origin (0, 0) in the lower right corner, with values increasing left and up as the image is viewed (figure 3).

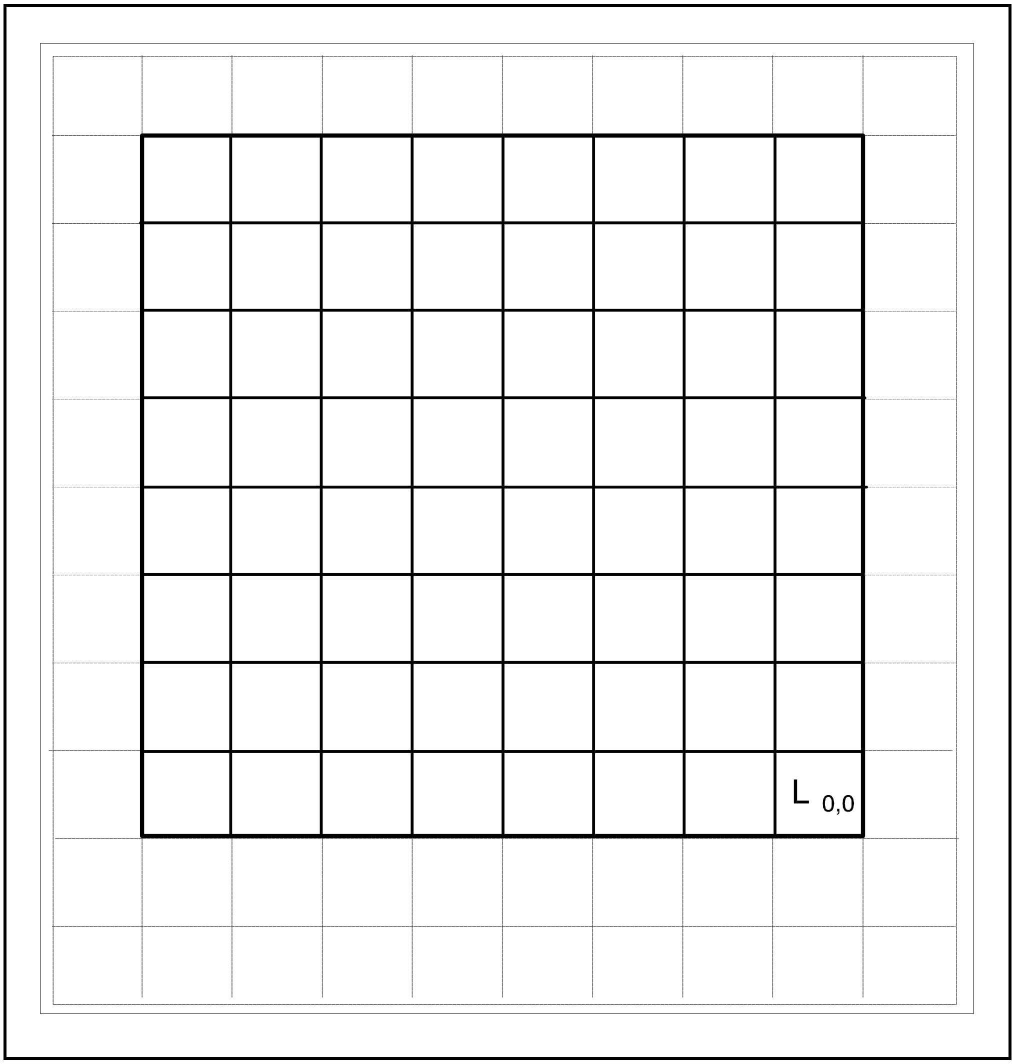


FIGURE 3. 8x8 neighborhood with Level 1 corner point.

5.2.2 Non-driven algorithm. Each image is divided into 8x8 pixel neighborhoods beginning in the upper left corner of the image and proceeding from left-to-right and top-to-bottom to the lower right corner. Each neighborhood is composed of four levels. Level 1 is the lower right corner pixel, or corner point of the neighborhood as shown on figure 3, and contains $1/64^{th}$ of the neighborhood area. Corner point values are used to compute the predicted values of the remaining pixels and are essential in decompression. Therefore, the actual pixel value ($L_{0,0}$) of the corner point is carried through in its original 8- and 11-bit resolution without computing and coding the delta.

5.2.2.1 Artificial rows and columns. The prediction computation uses pixel values in the bottom row of the neighborhood immediately above the current neighborhood and the rightmost column of the neighborhood immediately to the left of the current neighborhood. For neighborhoods not located on the top or left edge of the image, the actual edge pixels from surrounding neighborhoods are used to fill the ninth row and column. However, prior to calculating the predicted values for any neighborhood along the top edge or left edge of the image, an artificial ninth row or column must be created to supply these values. For the first neighborhood in the upper left corner of the image, both an artificial row above and column to the left of the neighborhood must be created. Pixel values for both the artificial row and column are shown on figure 4 and are as follows:

$$L_{8,8} = L_{0,0} \qquad L_{8,6} = L_{0,6} \qquad L_{8,4} = L_{0,4}$$
$$L_{0,8} = L_{0,0} \qquad L_{2,8} = L_{2,0} \qquad L_{8,2} = L_{0,2}$$
$$L_{8,0} = L_{0,0} \qquad L_{4,8} = L_{4,0} \qquad L_{6,8} = L_{6,0}$$

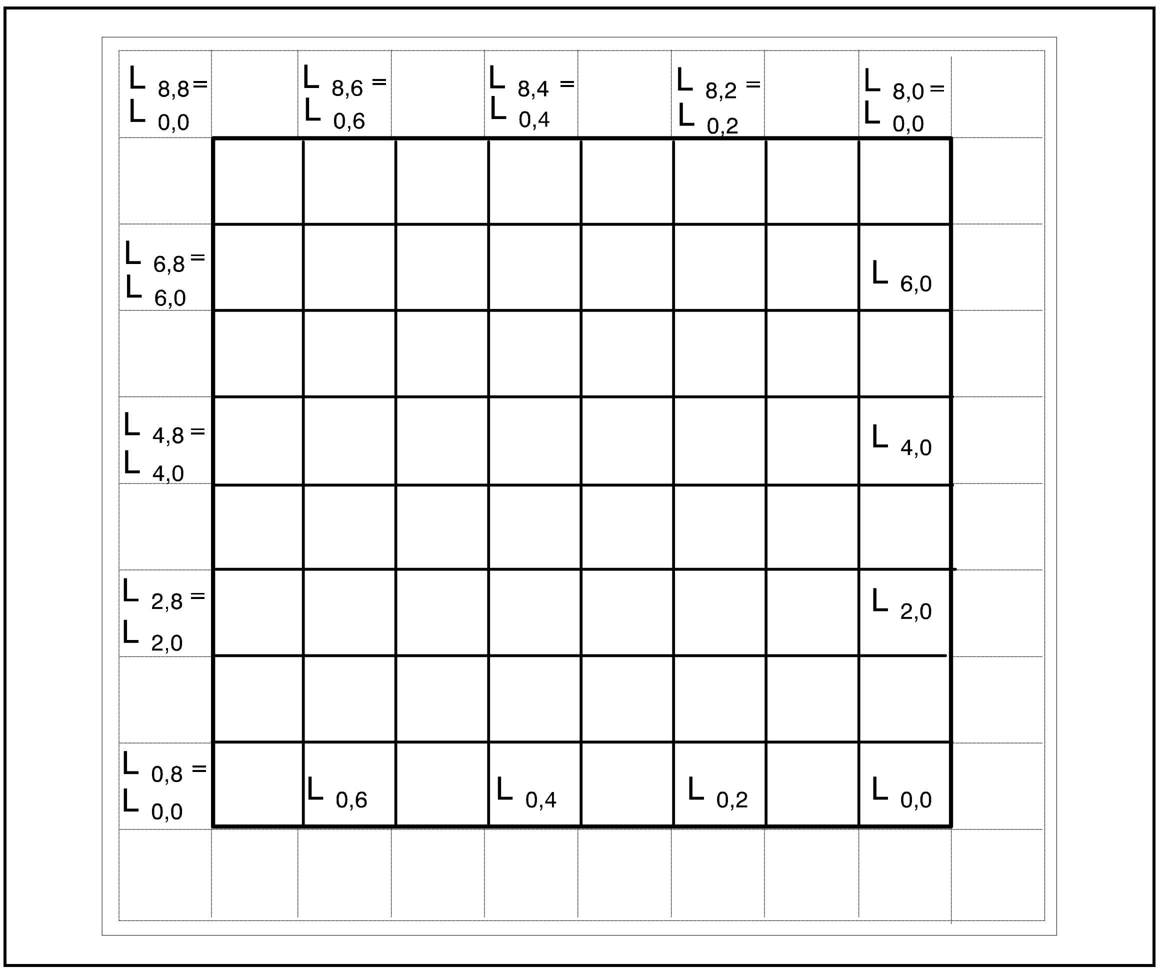


FIGURE 4. Top left corner of image prior to calculating predicted values.

For neighborhoods along the top edge of the image to the right of the first neighborhood, an artificial ninth row above must be created. The required pixel values for this row are given below. Note that values for the ninth column to the left ($L_{0,8}$ $L_{2,8}$ $L_{4,8}$ and $L_{6,8}$) are obtained from the rightmost column of the neighborhood to the immediate left.

$L_{8,8} = L_{0,8}$	$L_{8,0} = L_{0,0}$
$L_{8,4} = L_{0,4}$	$L_{8,2} = L_{0,2}$
$L_{8,6} = L_{0,6}$	

For neighborhoods along the left edge of the image below the first neighborhood, an artificial ninth column to the left must be created. The required pixel values for this column are given below. Note that values for the ninth row above ($L_{8,0}$ $L_{8,2}$ $L_{8,4}$ and $L_{8,6}$) are obtained from the bottom row of the neighborhood immediately above.

$L_{8,8} = L_{8,0}$	$L_{0,8} = L_{0,0}$
$L_{4,8} = L_{4,0}$	$L_{2,8} = L_{2,0}$
$L_{6,8} = L_{6,0}$	

When the neighborhood is not located on the top or left edge of the image, the actual edge pixels from surrounding neighborhoods are used to fill the 9th row and column.

5.2.2.2 Pixels at recursion level 2. Compression of Level 2 pixels consist of 3/64^{ths} of the neighborhood area as shown on figure 5.

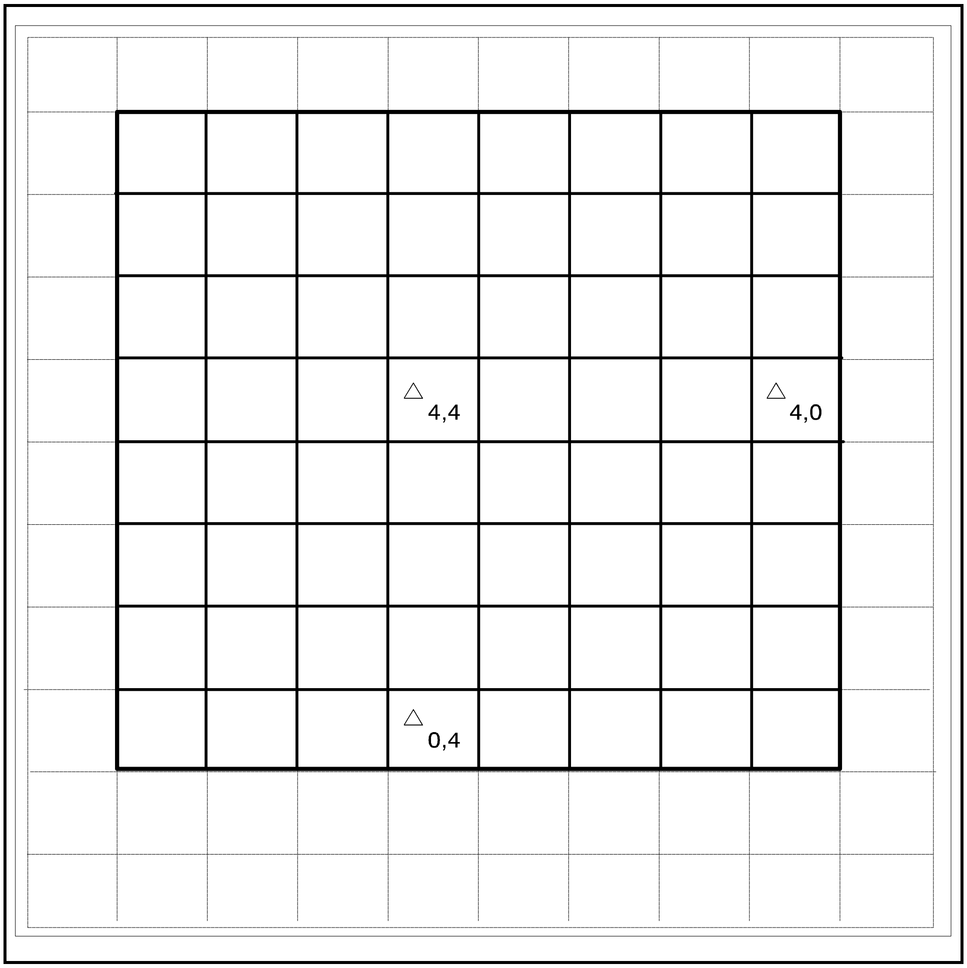
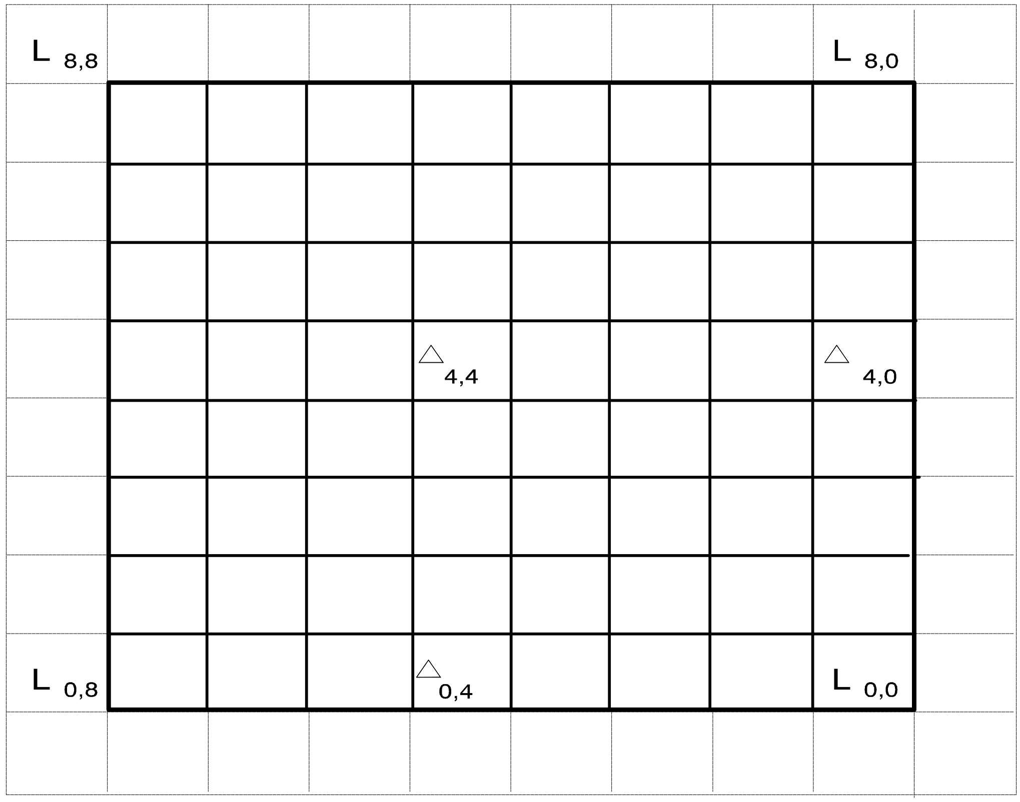


FIGURE 5. Level 2 deltas.

The predicted values of Level 2 pixels are computed in the following manner, as shown on figure 6.

$$P_{0,4} = (L_{0,0} + L_{0,8})/2$$
$$P_{4,0} = (L_{0,0} + L_{8,0})/2$$
$$P_{4,4} = (L_{0,0} + L_{0,8} + L_{8,0} + L_{8,8})/4$$



$L_{i,j}$ = Actual pixel value at Pixel i,j

$P_{i,j}$ = Predicted pixel value at Pixel i,j

$$P_{0,4} = (L_{0,0} + L_{0,8})/2$$

$$P_{4,0} = (L_{0,0} + L_{8,0})/2$$

$$P_{4,4} = (L_{0,0} + L_{0,8} + L_{8,0} + L_{8,8})/4$$

$$\triangle_{i,j} = L_{i,j} - P_{i,j}$$

FIGURE 6. Compute Level 2 deltas.

The equations for $P_{0,4}$ and $P_{4,0}$ may be recognized as simple interpolation, while $P_{4,4}$ is computed using bilinear interpolation. The delta values are then computed from the equation given above so that

$$\Delta_{0,4} = L_{0,4} - P_{0,4} \qquad \Delta_{4,0} = L_{4,0} - P_{4,0} \qquad \Delta_{4,4} = L_{4,4} - P_{4,4}$$

5.2.2.3 Pixels at recursion Level 3. Compression of Level 3 pixels comprises 12/64ths of the neighborhood area as shown on figure 7. The predicted values of Level 3 pixels are computed as given below, and the deltas are then computed as shown on figure 8.

$$P_{i,j} = (L_{i,j-2} + L_{i,j+2})/2 \qquad \text{for } i = 0, 4 \text{ and } j = 2, 6$$
$$P_{i,j} = (L_{i-2,j} + L_{i+2,j})/2 \qquad \text{for } i = 2, 6 \text{ and } j = 0, 4$$
$$P_{i,j} = (L_{i-2,j-2} + L_{i-2,j+2} + L_{i+2,j-2} + L_{i+2,j+2})/4 \qquad \text{for } i = 2, 6 \text{ and } j = 2, 6$$

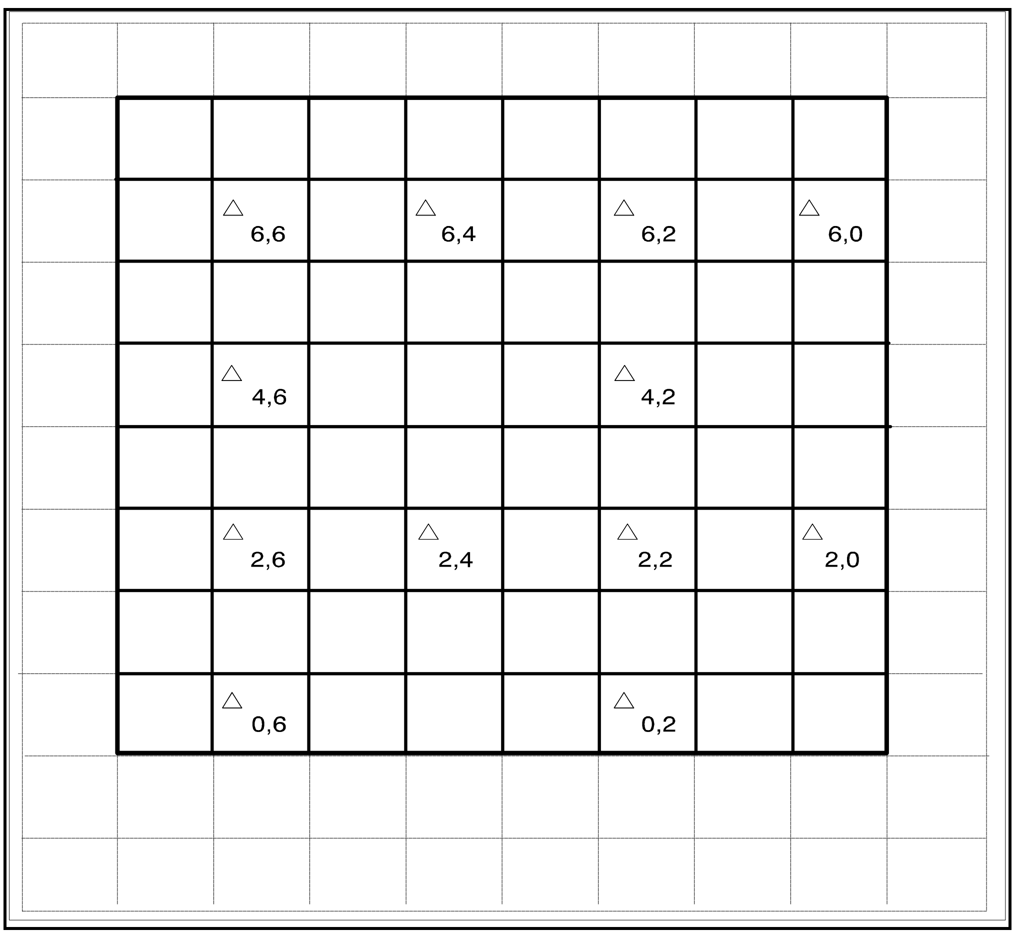
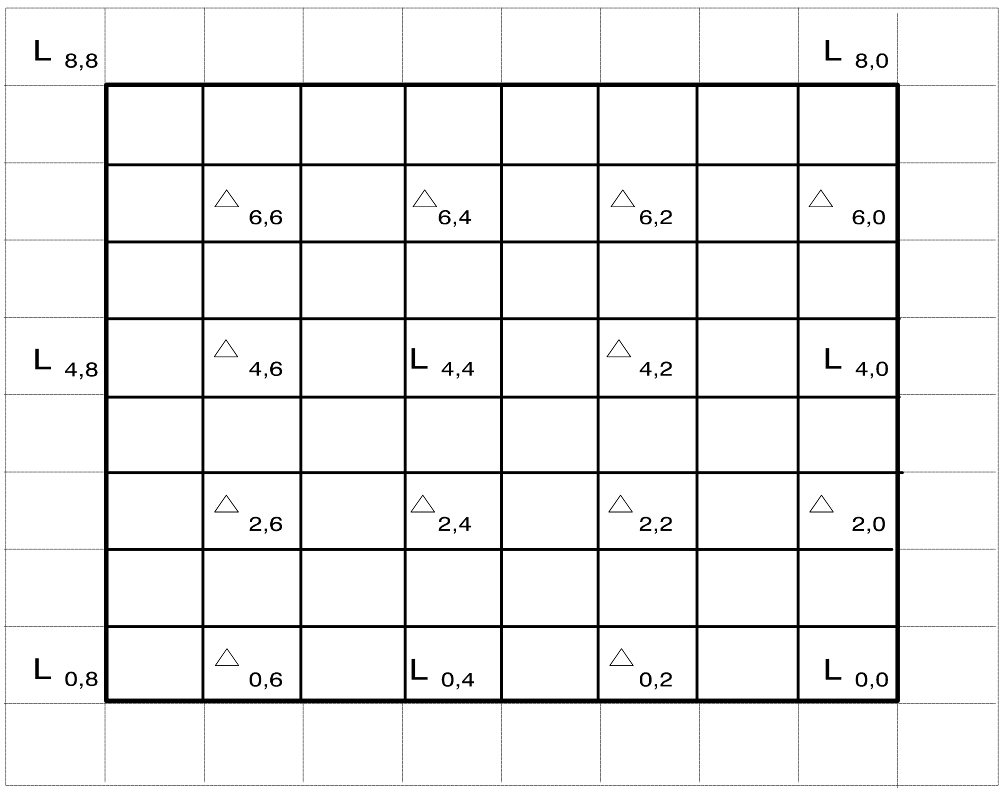


FIGURE 7. Level 3 deltas.



$L_{i,j}$ = Actual pixel value at Pixel i,j

$P_{i,j}$ = Predicted pixel value at Pixel i,j

$$P_{0,2} = (L_{0,0} + L_{0,4})/2$$

$$P_{2,0} = (L_{0,0} + L_{4,0})/2$$

$$P_{2,2} = (L_{0,0} + L_{0,4} + L_{4,0} + L_{4,4})/4$$

$$\triangle_{i,j} = L_{i,j} - P_{i,j}$$

FIGURE 8. Compute Level 3 deltas.

5.2.2.4 Pixels at recursion Level 4. The remaining pixels, or 48/64ths of the neighborhood area, are Level 4, as shown on figure 9. Level 4 predicted values are computed using the following equations, and the remaining deltas are computed.

$P_{i,j} = (L_{i,j-1} + L_{i,j+1})/2$ for $i = 0, 2, 4, 6$ and $j = 1, 3, 5, 7$
$P_{i,j} = (L_{i-1,j} + L_{i+1,j})/2$ for $i = 1, 3, 5, 7$ and $j = 0, 2, 4, 6$
$P_{i,j} = (L_{i-1,j-1} + L_{i-1,j+1} + L_{i+1,j-1} + L_{i+1,j+1})/4$ for $i = 1, 3, 5, 7$ and $j = 1, 3, 5, 7$

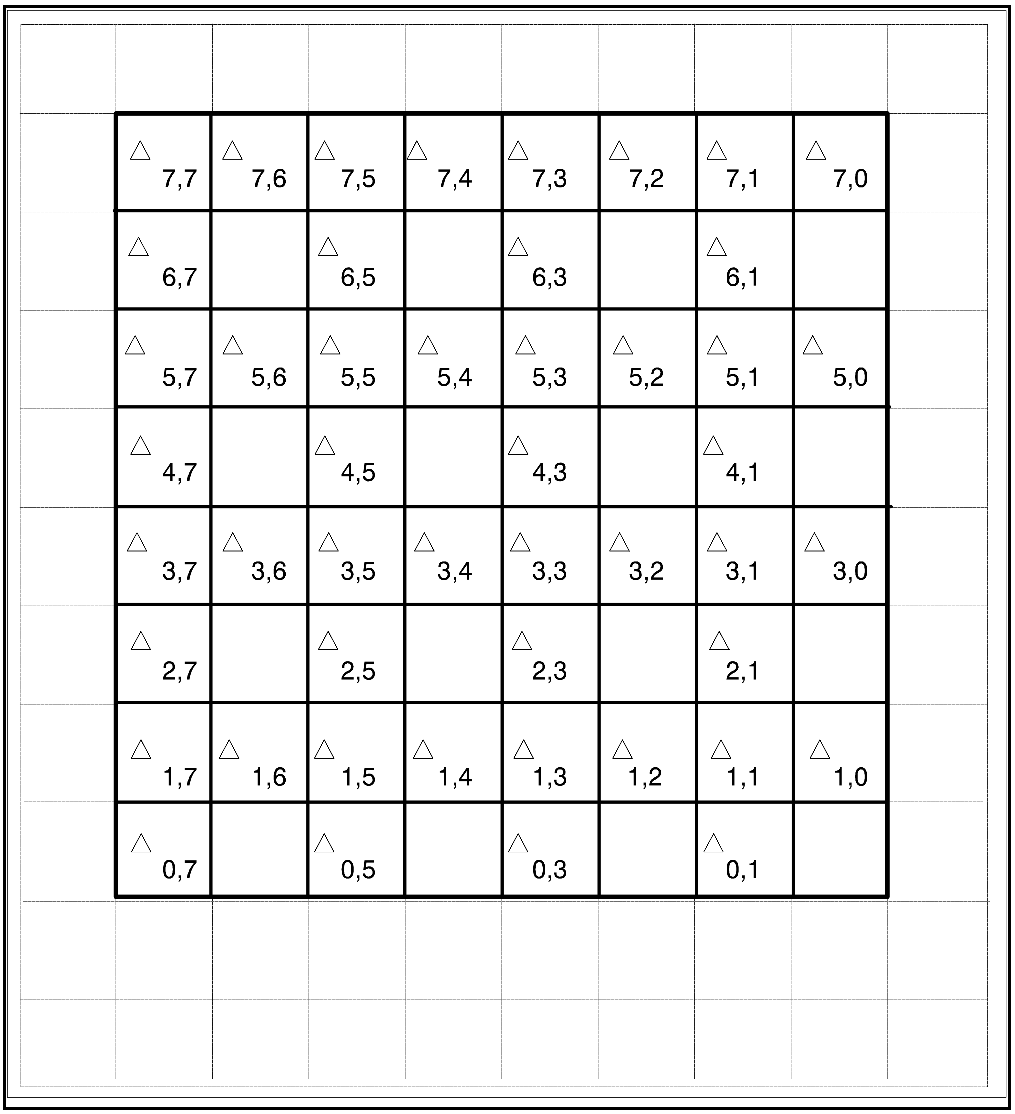


FIGURE 9. Level 4 deltas.

5.2.2.5 Busyness. Once all the delta values within the neighborhood have been computed, the busyness measure of the neighborhood is determined. Busyness is a function of how much pixel values change within a neighborhood. Therefore, a high contrast image gives a greater busyness measure than a low contrast image. Busyness is computed as follows:

$$\text{Busyness} = \text{Max}(\Delta_4) - \text{Min}(\Delta_4)$$

where $\text{Max}(\Delta_4)$ is the maximum Level 4 delta value of the neighborhood, and $\text{Min}(\Delta_4)$ is the minimum Level 4 delta value of the neighborhood. Level 4 deltas are used to compute busyness, because Level 4 pixels are correlated highly with the rest of the image and they comprise 75 percent of the image area. Strong edges appearing in the image will appear in the Level 4 deltas, causing neighborhoods with high edge content to be classified properly. The busyness value of a neighborhood may range from zero to +510 for 8- bit compression and may range from zero to +4095 for 11- bit compression. Each neighborhood is categorized into one of 4 busyness classes according to the busyness measure. The busyness classes and codes corresponding to the busyness measure are given in table I, for 8- bit compression and table II for 11- bit compression. Busyness class A represents the least busy region, and D represents the most busy region.

TABLE I. Busyness classes for eight- bit compression.

COMPRESSION SELECTED (BPP)	BUSYNESS MEASURE	BUSYNESS CLASS	BUSYNESS CODE
4.5	0 - 37 38 - 47 48 - 76 77 - 510	A B C D	00 01 10 11
2.3	0 - 37 38 - 54 55 - 93 94 - 510	A B C D	00 01 10 11
1.4	0 - 39 40 - 57 58 - 98 99 - 510	A B C D	00 01 10 11
0.75	0 - 44 45 - 79 80 - 122 123 - 510	A B C D	00 01 10 11

TABLE II. Busyness classes for 11-bit compression.

COMPRESSION SELECTED (BPP)	BUSYNESS MEASURE	BUSYNESS CLASS	BUSYNESS CODE
6.4	0 - 23 24 - 53 54 - 115 116 - 4095	A B C D	00 01 10 11
4.5	0 - 23 24 - 53 54 - 115 116 - 4095	A B C D	00 01 10 11
2.3	0 - 25 26 - 67 68 - 139 140 - 4095	A B C D	00 01 10 11
1.4	0 - 27 28 - 71 72 - 139 140 - 4095	A B C D	00 01 10 11

5.2.2.5.1 Bit Assignment Matrix. A BAM is selected as a function of the Busyness Class and the user-selected compression rate given in the NITF image subheader (0.75, 1.4, 2.3, or 4.5 bpp for 8-bit gray scale image and 1.4, 2.3, 4.5 or 6.4 bpp for 11-bit gray scale image). The selected BAM is used to determine the number of bits used to code each pixel in each neighborhood. For the corner point and all instances of 8-bit codes, actual pixel values are used rather than quantized deltas. Table III and table IV shows the BAMs for an 8-bit and 11-bit database, respectively. For example, if the user selected to compress an eight-bit image to 1.4 bits per pixel and the busyness class of a neighborhood is A, the BAM is 8-5-3-0 (such as, the corner point remains 8 bits, Level 2 deltas are given 5 bits, Level 3 deltas are given 3 bits, and Level 4 deltas receive zero bits). The actual compression rate using this example is 0.92 bits per pixel for that neighborhood.

TABLE III. Bit Assignment Matrices.

COMPRESSION SELECTED (BPP)	NUMBER OF BITS/ LEVEL				ACTUAL BPP	BUSYNESS	
	L1	L2	L3	L4		CLASS	CODE
4.5	8	7	3	2	2.51	A	00
	8	7	5	3	3.64	B	01
	8	8	7	5	5.56	C	10
	8	8	8	7	7.25	D	11
2.3	8	7	3	0	1.02	A	00
	8	7	6	0	1.58	B	01
	8	7	5	3	3.64	C	10
	8	8	7	4	4.81	D	11
1.4	8	5	3	0	0.92	A	00
	8	7	3	0	1.02	B	01
	8	7	5	0	1.39	C	10
	8	7	6	3	3.80	D	11
0.75	8	5	0	0	0.36	A	00
	8	5	2	0	0.74	B	01
	8	6	4	0	1.16	C	10
	8	7	4	2	2.70	D	11

TABLE IV. Bit Assignment Matrices.

COMPRESSION SELECTED (BPP)	NUMBER OF BITS/ LEVEL				ACTUAL BPP	BUSYNESS	
	L1	L2	L3	L4		CLASS	CODE
6.4	11	11	7	4	5.0	A	00
	11	11	7	5	5.75	B	01
	11	11	11	6	7.25	C	10
	11	11	11	7	8.0	D	11
4.5	11	6	3	2	2.51	A	00
	11	6	5	3	3.64	B	01
	11	11	6	5	5.56	C	10
	11	11	11	6	7.25	D	11
2.3	11	8	3	0	1.10	A	00
	11	8	4	0	1.29	B	01
	11	8	6	3	3.92	C	10
	11	11	8	4	5.18	D	11
1.4	11	7	0	0	0.5	A	00
	11	8	2	0	0.92	B	01
	11	8	5	0	1.48	C	10
	11	8	6	4	4.67	D	11

5.2.2.6 Quantization. The process of converting the deltas to fewer bits is called quantization, which provides the actual compression. For ARIDPCM, quantization and dequantization are performed using one set of static look- up tables. These quantization tables must be stored in the decompressing processor as well as in the compressing processor. The appendices contain the look- up tables used to quantize and code each delta. The quantization table is composed of two columns, one giving the expected delta value E[Δ], with the other column giving the code corresponding to E[Δ]. A given delta is quantized by selecting the E[Δ] closest in value to the delta. If the given delta is equidistant from two expected delta values, the expected delta closest to zero is chosen. If the given delta is zero and the two closest table entries are equidistant from zero, the positive table value is chosen. The code corresponding to the chosen E[Δ] is then used. When dequantizing, the given code is found in the table and its corresponding expected value, E[Δ], is determined.

5.2.2.7 Compressed data format. Figure 2 shows the NITF file format of the compressed data for the above configuration. All the busyness codes are placed together prior to all the neighborhoods. The coded deltas are ordered in the file as described in table V and shown on figure 10, beginning with point 0,0.

TABLE V. Output order of compressed data.

LEVEL	PIXEL	LEVEL	PIXEL	PIXEL	PIXEL
Level 1	0,0	Level 4	0,1	3,2	5,5
Level 2	0,4		1,0	3,3	4,7
	4,0		1,1	2,5	5,6
	4,4		0,3	3,4	5,7
Level 3	0,2		1,2	3,5	6,1
	2,0		1,3	2,7	7,0
	2,2		0,5	3,6	7,1
	0,6		1,4	3,7	6,3
	2,4		1,5	4,1	7,2
	2,6		0,7	5,0	7,3
	4,2		1,6	5,1	6,5
	6,0		1,7	4,3	7,4
	6,2		2,1	5,2	7,5
	4,6		3,0	5,3	6,7
	6,4		3,1	4,5	7,6
	6,6		2,3	5,4	7,7

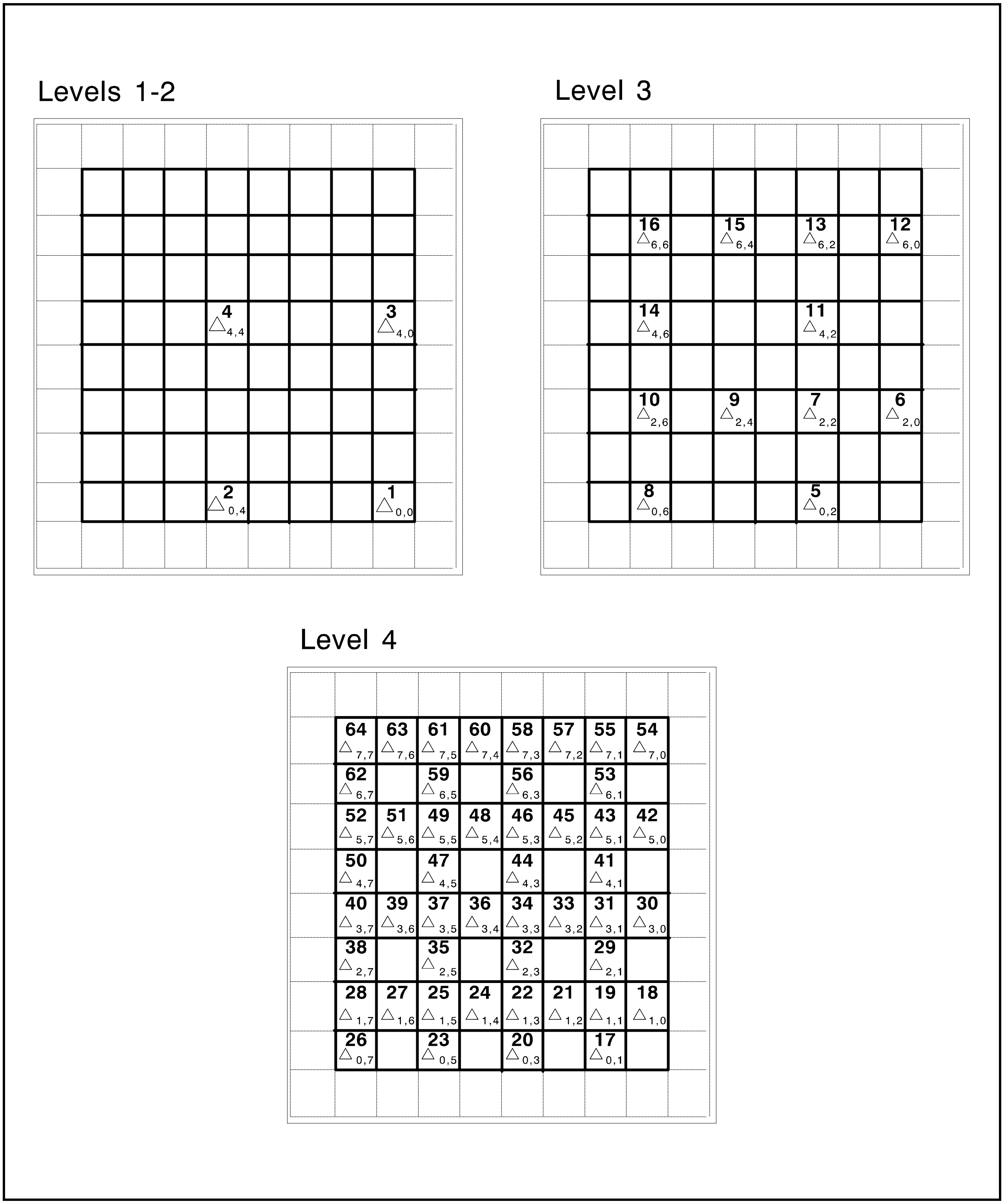


FIGURE 10. Output order of compressed data.

5.2.2.7.1 Resynchronization code. Resynchronization codes shall be used if specified in the Image Sync Code (ISYNC) field of the image subheader in accordance with MIL-STD-2500. The ISYNC is a one byte field that indicates if a synchronization code has been provided for uncompressed or ARIDPCM compressed data. A value of "zero" indicates that no code is inserted. A value of "four" indicates that a four- byte integer, byte aligned, has been inserted. The four byte value is the row number of the next row starting at zero and incrementing by eight for ARIDPCM. This code will provide a reference point for resynchronization of the image display in environments where the communications system cannot be expected to provide error free data, such as broadcast transmissions.

5.2.2.8 Decompression. To decode (reconstruct) the image, the reverse of the compression process is used. From the compression rate in the NITF image subheader and the busyness code preceding the coded data for a given 8x8 neighborhood, the BAM is determined to decipher the number of bits with which each level has been coded. The Level 1 corner point always remains in its original form with the actual pixel value $L_{0,0}$ at full bit resolution, therefore, no dequantization is required. Other pixels with full bit resolution are treated similarly. Next, the expected value for each of the coded deltas ($E[\Delta]$) is obtained from the quantization look- up tables in appendix A or appendix B.

5.2.2.8.1 Level 2. Using the corner point values of this and the three adjacent neighborhoods, the Level 2 pixel values are predicted. When neighborhoods are located on the top and left edge of the image, the same replication equations used for compression are used in decompression. The reconstructed corner point values ($R_{0,0}$, $R_{0,8}$, $R_{8,0}$, and $R_{8,8}$) equal the actual pixel values of the corner points ($L_{0,0}$, $L_{0,8}$, $L_{8,0}$, and $L_{8,8}$), respectively. The predicted value is added to the expected delta value to obtain the reconstructed pixel value.

$E[\Delta_{i,j}]$=Expected value of $\Delta_{i,j}$ after dequantization
$R_{i,j}=E[\Delta_{i,j}]+P_{i,j}$
$R_{i,j}$=Reconstructed pixel value at pixel i,j
$P_{i,j}$ =Predicted pixel value at pixel i,j
$P_{0,4}=(R_{0,0} + R_{0,8})/2$
$P_{4,0}=(R_{0,0} + R_{8,0})/2$
$P_{4,4}=(R_{0,0} + R_{0,8} + R_{8,0} + R_{8,8})/4$

The reconstructed values are then computed from the equation given above.

$$R_{0,4}=E[\Delta_{0,4}] + P_{0,4}$$
$$R_{4,0}=E[\Delta_{4,0}] + P_{4,0}$$
$$R_{4,4}=E[\Delta_{4,4}] + P_{4,4}$$

The Level 2 pixels in the adjacent or ninth row and column ($R_{4,8}$ and $R_{8,4}$) are also reconstructed to be used in the reconstruction of the Level 3 pixels within the neighborhood being decompressed.

$$P_{4,8}=(R_{0,8} + R_{8,8})/2 \qquad P_{8,4}=(R_{8,0} + R_{8,8})/2$$
$$R_{4,8}=E[\Delta_{4,8}] + P_{4,8} \qquad R_{8,4}=E[\Delta_{8,4}] + P_{8,4}$$

5.2.2.8.2 Level 3. The reconstructed Level 2 pixel values and the corner points are used to predict the Level 3 values. The predicted values of Level 3 pixels are computed with the equations given below, and the reconstructed values then are computed as shown previously.

$P_{ij}=(R_{ij-2} + R_{ij=2})/2$	for i = 0, 4, 8 and j = 2, 6
$P_{ij}=(R_{i-2j} + R_{i+2j})/2$	for i = 2, 6 and j = 0, 4, 8
$P_{ij}=(R_{i-2j-2} + R_{i-2j+2} + R_{i+2j+2})/4$	for i = 2, 6 and j = 2, 6

Note: In the above equations, the Level 3 pixels in the adjacent or ninth row and column ($R_{2,8}$, $R_{6,8}$, $R_{8,2}$, and $R_{8,6}$) are also reconstructed at this time. They will be used in the reconstruction of the Level 4 pixels within the neighborhood being decompressed. For each of the Level 3 pixels predicted above, the reconstructed value is then computed using the equation:

$$R_{i,j}=E[\Delta_{i,j}] + P_{i,j}$$

5.2.2.8.3 Level 4. The Level 4 predicted values are calculated using corner point values and all the other reconstructed values. Level 4 predicted values are computed using the following equations.

$P_{i,j}=(R_{i,j-1} + R_{i,j+1})/2$	for i = 0, 2, 4, 6 and j = 1, 3, 5, 7
$P_{i,j}=(R_{i-1j} + R_{i+1j})/2$	for i = 1, 3, 5, 7 and j = 0, 2, 4, 6
$P_{i,j}=(R_{i-1,j-1} + R_{i-1,j+1} + R_{i+1,j+1})/4$	for i = 1, 3, 5, 7 and j = 1, 3, 5, 7

The remaining reconstructed values are then computed.

$$R_{i,j}=E[\Delta_{i,j}] + P_{i,j}$$

The reconstruction of all pixel values within the 8x8 neighborhood is then complete, and may be used for display, storage, or other manipulation.

5.2.3 Driven algorithm. The driven algorithm is globally adaptive while the non-driven is locally adaptive over an 8x8 pixel neighborhood. The driven algorithm is computed in the same manner as the non-driven until the selection of the BAM. The driven algorithm is a two pass operation. On the first pass, busyness measures of each neighborhood are calculated. All deltas for every neighborhood in the image are computed prior to selection of any BAMs. A specific percentage of the neighborhoods are then placed into each busyness class in order to reach the user-selected compression rate. The percentages of neighborhoods that are placed in each busyness class are shown in table VI for an 8-bit compression and in table VII for 11-bit compression. For example, as shown in table VI, for an 8-bit image at a compression rate of 1.4, the 13 percent of the neighborhoods with the highest busyness measure are coded using the Class D BAM, the next 20 percent of the neighborhoods use Class C, the next 32 percent are placed in Class B, and the 35 percent with the lowest busyness measures are assigned to Class A. The second pass uses the derived percentages and compression rate to perform the compression in the same manner as the non-driven mode.

TABLE VI. Percentages of neighborhoods placed in busyness classes (for eight bpp inputs).

COMPRESSION RATE BPP	PERCENTAGE OF NEIGHBORHOODS IN CLASS			
	A	B	C	D
4.5	30	25	25	20
2.3	33	31	22	14
1.4	35	32	20	13
0.75	50	32	10	8

TABLE VII. Percentages of neighborhoods placed in busyness classes (for 11 bpp inputs).

COMPRESSION RATE BPP	PERCENTAGE OF NEIGHBORHOODS IN CLASS			
	A	B	C	D
6.4	30	25	25	20
4.5	30	25	25	20
2.3	33	31	22	14
1.4	35	32	20	13

5.2.4 Composite mode. The non- driven and driven algorithms are used to specify image quality and image compression rate, respectively. Composite mode combines these techniques to compress areas with little detail more than those areas with higher detail or with a specific region of interest. The region of interest is specified by the operator, and this region is coded using the highest BAM for the selected compression rate, while the rest of the area is coded using the lowest BAM. Image detail is preserved by using more bits to maintain higher image fidelity over the region of interest. Decompression is performed as described previously. The exact use of the composite mode is determined by the system developer.

5.2.5 Special considerations.

5.2.5.1 Required image sizes. The ARIDPCM requires that image dimensions be multiples of eight along the vertical and horizontal axes. When an image does not contain enough data to fill an 8x8 neighborhood along the rightmost or bottom edge, prior to beginning compression, the pixel values in the bottom row and/or rightmost column are replicated to fill the neighborhood down and/or across. The neighborhood is compressed normally.

6. NOTES

(This section contains general or explanatory information that may be helpful but is not mandatory).

6.1 Purpose of NITFS. The primary purpose of the NITFS is the transmission of a file composed of a base image accompanied by additional images, symbols, labels, text, and other information which relate to the base image. NITFS defines a standard format for the transmission of digital imagery and image-related products by the Department of Defense and other members of the Intelligence Community. The NITFS provides a common basis for the digital interchange of images and associated data among a variety of existing and future systems. NITFS is designed to be used for secondary dissemination of images, text, and associated data.

6.2 Selection of ARIDPCM for NITFS. Among the criteria for selecting the ARIDPCM compression algorithm over other methods were that the algorithm can compress a 512x512 image on an IBM PC AT or compatible in two minutes or less, data can be compressed to two bits per pixel with acceptable image quality loss, and the algorithm is implementable on a chip. Other strengths of the ARIDPCM are low transmission overhead, medium computational requirements, very good Very High Speed Integrated Circuit (VHSIC) suitability, maintains edges while sacrificing areas with little detail, and good versatility (compression can be driven by defining the needed image quality or by defining the transmission requirements). The ARIDPCM requires only a few basic integer arithmetic operations:

a. Addition

b. Subtraction

c. Shifts (division by powers of two).

6.3 ARIDPCM quantization table derivation. This paragraph details how the quantization tables were derived, but the process described is not to be performed as a part of the ARIDPCM compression algorithm. The quantization tables were developed by computing the deltas for a collection of sample images. The population distribution of a particular delta level for an entire image was determined and divided into N continuous regions of equal population where $N = 2^x$ with x representing the number of bits to be used in coding the delta. For example, in developing a table to quantize the Level 3 deltas using two bits, the delta values were plotted against the number of occurrences of each value. The probability distribution for the deltas was divided into four continuous regions of values each with 25 percent probability. To put it another way, the plot of delta values was divided so that 25 percent of the delta values fall within the region to be coded with the bit value 00, 25 percent in the region coded by 01, 25 percent in the ten region, and the remaining 25 percent of the delta values to be coded using the bit pattern 11. For each of these regions denoted by a specific code, the expected value of the delta was computed to be used in the dequantization tables.

6.4 Critical/important data. The busyness codes are considered critical data when transmitting the compressed image.

6.5 Other than eight- and 11-bit compression. ARIDPCM is defined only for 8- and 11-bit images. Therefore, images that are either below 8 bits-per-pixel or are nine to ten bits-per-pixel must be transformed to the next highest bit rate the compression algorithm can process. The recommended method is to convert other than M-bit imagery into M-bit imagery using the following equation where M equals the number of bits required by the compression algorithm.

N = number of bits-per-pixel
P_N = N-bit pixel value
P_M = M-bit pixel value

$$P_M = \frac{2^M - 1}{2^N - 1} P_N$$

Images that are 2 to 7 bits-per-pixel should be transformed to 8 bits. Images that are 9 to 10-bit images should be extended to 11 bits. One-bit images should use the alternate NITFS compression algorithm. Greater than 11-bit images should be reduced to 11 bits-per-pixel.

6.6 Quantization tables. As an example, the quantization tables for the 0.75 bits-per-pixel 8-bit compression rate are shown in appendix A. The rest of the quantization tables and the BAMs are on magnetic media and may be obtained from DISA/JIEO/CFS/TBCE, Parkridge III, 10701 Parkridge Blvd., Reston, VA 22091-4398.

6.7 Subject term (key word) listing.

BWC
Compression Algorithm
Continuous Tone Imagery
Gray Scale Imagery
Image Compression
Secondary Imagery Dissemination Systems
SIDS

APPENDIX A

BAMS AND QUANTIZATION TABLES

10. GENERAL

10.1 Scope. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. Applicable. This section is not applicable to this appendix.

30. Definitions. This section is not applicable to this appendix.

40. GENERAL REQUIREMENTS

40.1 Requirements. This appendix specifies that additional quantization tables are available on magnetic media or in hard copy. Additional BAMS and Quantization Tables may be obtained on disk or in hard copy from TBCE, Parkridge III, 10701 Parkridge Blvd., Reston, VA 22091-4398.

TABLE A-I. Bit Assignment Matrices.

COMPRESSION	**NUMBER OF BITS/ LEVEL**				**ACTUAL**	**BUSYNESS**	
SELECTED (BPP)	**L1**	**L2**	**L3**	**L4**	**BPP**	**CLASS**	**CODE**
0.75	8	5	0	0	0.36	A	00
	8	5	2	0	0.74	B	01
	8	6	4	0	1.16	C	10
	8	7	4	2	2.70	D	11

TABLE A-II. Class A Level 2 (five bits).

E[Δ]	CODE	E[Δ]	CODE
-71	00000	1	10000
-49	00001	2	10001
-38	00010	4	10010
-32	00011	6	10011
-27	00100	8	10100
-23	00101	10	10101
-20	00110	12	10110
-17	00111	14	10111
-14	01000	16	11000
-12	01001	19	11001
-10	01010	22	11010
-8	01011	26	11011
-6	01100	31	11100
-4	01101	37	11101
-3	01110	46	11110
-1	01111	72	11111

TABLE A-III. Class B Level 3 (two bits).

E[Δ]	CODE
-24	00
-6	01
6	10
24	11

TABLE A-IV. Class B Level 2 (five bits).

E[Δ]	CODE	E[Δ]	CODE
-71	00000	1	10000
-49	00001	2	10001
-38	00010	4	10010
-32	00011	6	10011
-27	00100	8	10100
-23	00101	10	10101
-20	00110	12	10110
-17	00111	14	10111
-14	01000	16	11000
-12	01001	19	11001
-10	01010	22	11010
-8	01011	26	11011
-6	01100	31	11100
-4	01101	37	11101
-3	01110	46	11110
-1	01111	72	11111

TABLE A-V. Class C Level 2 (six bits).

E[Δ]	CODE	E[Δ]	CODE
- 109	000000	- 4	011001
- 82	000001	- 3	011010
- 68	000010	- 2	011011
- 59	000011	- 1	011100
- 52	000100	0	011101
- 46	000101	1	011110
- 41	000110	2	011111
- 37	000111	3	100000
- 33	001000	4	100001
- 30	001001	5	100010
- 27	001010	6	100011
- 25	001011	7	100100
- 22	001100	8	100101
- 20	001101	9	100110
- 18	001110	10	100111
- 16	001111	11	101000
- 15	010000	12	101001
- 13	010001	13	101010
- 11	010010	14	101011
- 10	010011	15	101100
- 9	010100	16	101101
- 8	010101	17	101110
- 7	010110	18	101111
- 6	010111	19	110000
- 5	011000	20	110001

E[Δ]	CODE	E[Δ]	CODE
21	110010	42	111001
24	110011	47	111010
26	110100	52	111011
28	110101	60	111100
31	110110	69	111101
35	110111	85	111110
38	111000	118	111111

TABLE A-VI. Class C Level 3 (four bits).

E[Δ]	CODE	E[Δ]	CODE
- 68	0000	1	1000
- 37	0001	4	1001
- 23	0010	7	1010
- 15	0011	10	1011
- 9	0100	16	1100
- 6	0101	24	1101
- 3	0110	37	1110
- 1	0111	70	1111

TABLE A-VII. Class D Level 3 (four bits).

E[Δ]	CODE	E[Δ]	CODE
- 117	0000	- 1	1000
- 72	0001	3	1001
- 50	0010	7	1010
- 36	0011	14	1011
- 25	0100	25	1100
- 17	0101	45	1101
- 10	0110	82	1110
- 5	0111	166	1111

TABLE A-VIII. Class D Level 4 (two bits).

E[Δ]	CODE
- 47	00
- 8	01
4	10
43	11

TABLE A-IX. Class D Level 2 (seven bits).

E[Δ]	CODE	E[Δ]	CODE
-159	0000000	-42	0011001
-134	0000001	-40	0011010
-122	0000010	-39	0011011
-113	0000011	-37	0011100
-106	0000100	-36	0011101
-100	0000101	-35	0011110
-94	0000110	-33	0011111
-88	0000111	-32	0100000
-83	0001000	-31	0100001
-79	0001001	-30	0100010
-76	0001010	-29	0100011
-72	0001011	-28	0100100
-69	0001100	-27	0100101
-66	0001101	-25	0100110
-63	0001110	-24	0100111
-61	0001111	-23	0101000
-58	0010000	-22	0101001
-56	0010001	-21	0101010
-54	0010010	-20	0101011
-52	0010011	-19	0101100
-50	0010100	-18	0101101
-48	0010101	-17	0101110
-47	0010110	-16	0101111
-45	0010111	-15	0110000
-43	0011000	-14	0110001

E[Δ]	**CODE**	**E[Δ]**	**CODE**
-13	0110010	12	1001011
-12	0110011	13	1001100
-11	0110100	14	1001101
-10	0110101	15	1001110
-9	0110110	16	1001111
-8	0110111	17	1010000
-7	0111000	18	1010001
-6	0111001	19	1010010
-5	0111010	20	1010011
-4	0111011	21	1010100
-3	0111100	22	1010101
-2	0111101	23	1010110
-1	0111110	24	1010111
0	0111111	25	1011000
1	1000000	26	1011001
2	1000001	27	1011010
3	1000010	28	1011011
4	1000011	29	1011100
5	1000100	30	1011101
6	1000101	31	1011110
7	1000110	32	1011111
8	1000111	33	1100000
9	1001000	34	1100001
10	1001001	35	1100010
11	1001010	36	1100011

E[Δ]	**CODE**	**E[Δ]**	**CODE**
37	1100100	73	1110010
38	1100101	79	1110011
39	1100110	85	1110100
40	1100111	92	1110101
41	1101000	100	1110110
42	1101001	109	1110111
43	1101010	118	1111000
45	1101011	130	1111001
48	1101100	144	1111010
52	1101101	159	1111011
56	1101110	177	1111100
60	1101111	196	1111101
64	1110000	217	1111110
68	1110001	236	1111111

APPENDIX B

ADDITIONAL BAMS AND QUANTIZATION TABLES

10. GENERAL

10.1 Scope. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. Applicable. This section is not applicable to this appendix.

30. Definitions. This section is not applicable to this appendix.

40. GENERAL REQUIREMENTS

40.1 Requirements. This appendix specifies that additional quantization tables are available on magnetic media or in hard copy. Additional BAMS and Quantization Tables may be obtained on disk or in hard copy from TBCE, Parkridge III, 10701 Parkridge Blvd., Reston, VA 22091-4398.

CONCLUDING MATERIAL

Custodians:
Army - SC
Navy - OM
Air Force - 02
Msc - DC

Review activities:
OASD - SO, DO, HP, IR
Army - AM, AR, MI, TM, MD,
CE, SC, IE, ET, AC, PT
DLA - DH
Msc - NS, MP, DI, NA

Civil agency coordinating activities:
USDA - AFS, APS
COM - NIST
DOE
EPA
GPO
HHS - NIH
DOI - BLM, GES, MIN
DOT - CGCT

Preparing activity:
Msc - DC

Agent:
Not applicable

(Project TCSS-1970)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1,2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-188-197a	2. DOCUMENT DATE (YYMMDD) 941012

3. DOCUMENT TITLE ARIDPCM COMPRESSION ALGORITHM FOR THE NITFS

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY DEFENSE INFORMATION SYSTEMS AGENCY (DISA)

a. NAME DISA/JIEO/CFS/TBCE	b. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON
c. ADDRESS *(Include Zip Code)* Parkridge III 10701 Parkridge Boulevard Reston, VA 22091-4398	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340